CLAIMS

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1. An apparatus for processing auscultation signals, comprising

a bias processor (106; 301; 409) for receiving an auscultation signal and providing a biased auscultation signal; said bias processor comprising an envelope detector;

an estimator (105; 302; 410) for calculating a signal representative of an estimated rhythm of the auscultation signal;

characterized in that,

the estimator is adapted for selecting at least a part of the biased auscultation signal as a first signal and calculating the conformity between the first signal and the biased auscultation signal.

2. An apparatus according to claim 1, characterized in that the estimator calculates a cross-correlation function.

3. An apparatus according to claims 1-2, characterized in that the first signal represents one of a succession of cycles of the biased auscultation signal.

4. An apparatus according to claim 1, characterized in that the estimator calculates an auto-correlation function.

5. An apparatus according to claims 1-4, characterized in that the quality of the auscultation signal is validated by verifying at one least of the following three items in

a signal representing the conformity of the auscultation signal:

a) time differences between located extreme values must be within predetermined limits;

b) minimum and maximum time differences in proportion to the mean of the time differences must be within predetermined limits;

c) the magnitude of the result of the correlation at the extreme values location must be within predetermined limits.

6. An apparatus according to claims 1-5, characterized in that the bias processor comprises a filter (101; 401) for calculating an A-weighted version of the auscultation signal or an approximated A-weighted version of the auscultation signal.

7. An apparatus according to claims 6, characterized in that the A-weighted version of the auscultation signal is calculated by means of an approximation corresponding to a double differentiation of the auscultation signal.

8. An apparatus according to claims 1-7, characterized in that the bias processor comprises an adaptive band-pass filter (512) for filtering signals provided by the envelope detector; said band-pass filter at least having an upper and a lower pass-band respectively selectable; said adaptive band-pass filter comprising a controller (513) selecting the lower pass-band when a relatively large fraction of a signal input to the band-pass filter is low-frequent and selecting the upper pass-band when a relatively low fraction of a signal input to the band-pass filter is low-frequent.

9. An apparatus according to claims 1-8, characterized in that the auscultation signal comprises samples that arrive at a sample rate and in that the apparatus comprises a synchronous processor (301; 409) operating at a rate corresponding to the sample rate, and further comprising an asynchronous processor (302; 410) operating at time intervals that are initiated by a request.

10. A stethoscope according to claims 1-9 comprising means for estimating the rhythm in an auscultation signal.

11. An apparatus for estimating the rhythm in auscultation signals, comprising

a bias processor (106; 301; 409) for receiving an auscultation signal and providing a biased auscultation signal; said bias processor comprising an envelope detector;

an estimator (105; 302; 410) for calculating a signal representative of an estimated rhythm of the auscultation signal;

characterized in that,

the bias processor comprises a filter (101; 401) having a frequency response corresponding to an A-weighing or an approximated A-weighing, at least for a frequency range of interest.

12. An apparatus according to claim 11, characterized in that the auscultation signal is filtered with a filter (101; 401) having a frequency response corresponding to a double differentiation.

13. An apparatus according to claim 11-12, characterized in that the frequency range of interest is the frequency range below 2000Hz.

14. A method of processing auscultation signals, comprising the steps of

receiving an auscultation signal and providing a biased auscultation signal;

calculating a signal representative of an estimated rhythm of the auscultation signal;

characterized in that,

the estimated rhythm is calculated by selecting at least a part of the biased auscultation signal as a first signal and calculating the conformity between the first signal and the biased auscultation signal.

15. A method according to claim 14, characterized in that the estimator calculates a cross-correlation function.

16. A method according to claims 14-15, characterized in that the part of the biased auscultation signal represents one of a succession of cycles of the biased auscultation signal.

17. A method according to claim 14, characterized in that the estimator calculates an auto-correlation function.

18. A method according to claims 14-17, characterized in that the quality of the auscultation signal is validated by verifying at least one of the following three items in a signal representing the conformity of the auscultation signal:

a) time differences between located extreme values must be within predetermined limits;

b) minimum and maximum time differences in proportion to the mean of the time differences must be within predetermined limits;

c) the magnitude of the result of the correlation at the extreme values location must be within predetermined limits.

19. A method according to claim 28-33, characterized in that the method further comprises a step of calculating an A-weighted version of the auscultation signal or an approximated A-weighted version of the auscultation signal.

20. A method according to claim 34, characterized in that the A-weighted version of the auscultation signal is calculated by means of an approximation corresponding to a double differentiation of the auscultation signal.

21. A method according to claim 14-20, characterized in that the method further comprises the step of filtering the biased auscultation signal by means of a band-pass filter; said band-pass filter at least having an upper and a lower pass-band respectively selectable; said adaptive band-pass filter being controlled such that the lower pass-band is selected when a relatively large fraction of a signal input to the band-pass filter is low-frequent and such that the upper pass-band is selected when a relatively low fraction of a signal input to the band-pass filter is low-frequent.

22. A method according to claim 14-21, characterized in that the auscultation signal comprises samples that arrive at a sample rate and in that the method comprises synchronous steps being executed at a rate corresponding to the sample rate, and further comprising asynchronous

steps operating at time intervals that are initiated by a request.

23. A method for estimating the rhythm in auscultation signals, comprising the steps of

receiving an auscultation signal and providing a biased auscultation signal;

calculating a signal representative of an estimated rhythm of the auscultation signal;

characterized in that,

the signal representative of the estimated rhythm is calculated by means of a filter having a frequency response corresponding to an A-weighing or an approximated A-weighing, at least for a frequency range of interest.

24. A method according to claim 23, characterized in that the frequency response is obtained by means of a double differentiation.

25. A method according to claim 14-24, characterized in that the frequency range of interest is the frequency range below 2000Hz.